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## STUDIES ON THE CHARCOAL ROT AND BACTERIAL STALK ROT OF MAIZE IN WEST BENGAL AND THEIR MANAGEMENT

By

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On maize, both charcoal rot (*Macrophomina phaseolina*) and bacterial stalk rot (*Erwinia chrysanthemi*) are of major importance in West Bengal situation. *M. phaseolina* is found to be prevalent in the plains only particularly on Rabi crop that is exposed to high summer temperature from the flowering stage. Symptoms of both *M. phaseolina* and *E. chrysanthemi* appear when the crop approach maturity. The distinguishing character of *M. phaseolina* is the presence of small black sclerotia (40-150 $\mu$  in diameter) in the disintegrated pith of the affected stalks. *E. chrysanthemi* has so far been detected in the hills only (Kaiser and Sen Gupta, 1979). Application of sweage water and late sowing seem to favour incidence of this disease. The bacterium produces soft rot on the basal portion of the stalk which become light brown and disintegrate with a disagreeable odour. Colonies on PDA medium are white cream coloured with undulate margins. Cells are straight rods measuring 0.5-1.0 x 1.0-2.0 $\mu$ m, motile by means of peritrichous flagella and Gram negative.

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Several workers have demonstrated the control of *Erwinia* stalk rot on maize by the application of stable Bleaching Powder in the soil (Sangam Lal et al., 1970; Thind and Payak, 1972). The present studies also indicate the potentiality of Bleaching Powder as a fungicidal agent against *M. phaseolina* in the soil. About 41.6-66.6% incidence of the disease was checked when this chemical was applied as soil drench. Late application before flowering was proved to be more effective than early application.

#### INTRODUCTION

Maize crop suffers from different stalk rot diseases caused by various fungi and bacteria. Among them *Pythium* stalk rot, charcoal rot and bacterial stalk rot are gradually becoming prevalent in this country. Both charcoal rot (*Macrophomina phaseolina* (Tassi Goid) and bacterial stalk rot (*Erwinia chrysanthemi* Burkholder) are found to be of major importance in West Bengal.

Symptoms of the disease in both the cases appear when the plants approach maturity. Plants affected with *M. phaseolina* show evidence of premature ripening. The outside of the lower internodes generally become straw coloured but sometimes become dark brown. The pith becomes badly disintegrated and shows little discolouration. The infected stalk may split longitudinally into a mass of fibres. A distinguishing character of the disease is the presence of small black sclerotia in the pith of affected stalks. They measure 40—115 $\mu$  in diameter and in some cases pycnidia measuring 145-200 $\mu$  in diameter are also observed. The pycniospores are oval to elliptical, hyaline, one celled and thin walled, measuring 12-25 $\mu$  x 6-10 $\mu$ .

Infection due to *E. chrysanthemi* is noticed as the rotting of the basal portion of the stalk which generally does not progress more than one internode. The infected plants become light brown, soft and disintegrate with a disagreeable odour. Severely infected plants show sign of wilting and fall over at the point where the stalk is rotted.

In West Bengal, charcoal rot is found to be prevalent in the plains only particularly in Rabi crop when summer temperature becomes comparatively high (35-40°C). It is also prevalent in the plains during kharif season. Incidence of this disease is directly correlated with both temperature rise and maturity of plants and consequently the incidence is much more in Rabi crop that is exposed to high summer temperature from the flowering stage. A gradual increase in the disease severity has been noted at the University Farm, Kalyani where jute-potato rotation was replaced by growing maize in the successive years.

Bacterial stalk rot due to *E. chrysanthemi* has so far been detected in hills only during the 1978 Kharif season at Kalimpong. On isolation, the bacterium produced white cream coloured colonies on Potato Dextrose Agar medium with undulate margins on 4-5th day. Cells were single straight rods measuring  $0.5-1.0 \times 1.0-2.0 \mu\text{m}$  and motile by means of peritrichous flagella. The bacterium was Gram negative, did not hydrolyze starch and was facultative anaerobe.

*E. chrysanthemi* has gained its importance in the recent years due to its progressive severity and at present it is considered to be the major stalk rot disease of maize at Kalimpong and its adjacent areas (Kaiser and Sen Gupta, 1979). Incidence of this disease is generally favoured by the application of sewage water for fertilizing the land prior to sowing. Late sowing of the crop from the end of May to the middle of June also increases its incidence.

Several attempts have been made for the effective control of *Erwinia* stalk rot of maize by the application of antibiotics like streptomycin and Sterptocycline (Sabet, 1956; Rangarajan and Chakravarti 1970). But the spraying with these antibiotics may not prove effective and economical, and their soil application is also not feasible due to their high costs and their binding and inactivation in the soil (Maier, 1960). Recently, Stable Bleaching Powder (Calcium Hypo-chlorite), having inhibitory effects against this bacterium has been found to be most suitable for soil application (Sangam Lal *et al.*, 1970; Thind and Payak, 1972).

Since both the pathogens (*M. phaseolina* and *E. chrysanthemi*) are known to be associated with soil, a programme for exploring the possibilities of reducing the incidence of *M. phaseolina* in sick plots was taken up with stable Bleaching

Powder during the 1978-1979 Rabi season at Kalyani considering the fact that chlorine is a general microbiocide at lower concentrations and considering the success of this chemical against *Erwinia*.

#### MATERIALS AND METHODS

Varietal entry included in the trial was hybrid Ganga-5 known to be susceptible to the charcoal rot disease. Seeds were obtained from the Project Coordinator (Maize) and the requisite quantity of Bleaching Powder was supplied by D. C. M. Chemical Works from New Delhi. Seeds were sown in sick plots and each treatment was represented by 6 rows of 5 meter length with 4 replications. Normal agronomic practices were followed and no plant protection measure was undertaken.

Bleaching Powder which contained 33% chlorine was applied as soil drench in three split doses i. e., 30-, 45-, and 60 days after the emergence of plants. Concentration used was 1000 ppm or 33.3 gm in 10 litres of water to cover an approximate area of 200 square feet. Side effect of the chemical was avoided by making a 'bundh' in between two treatments. Data was recorded at the flowering stage, about two weeks after the last chemical dose was applied. Scoring of disease was done on the basis of 1-10 scale, according to the instructions received from the Senior Maize Pathologist (Associate Project Coordinator) as follows :

- 1-25% of one internode discoloured.
- 2-26 to 50% of one internode discoloured.
- 3-51 to 75% of one internode discoloured.
- 4-76 to 100% of one internode discoloured.
- 5- Discolouration of less than 50% of adjacent internode.
- 6-Discolouration of more than 50% of adjacent internode.
- 7-Discolouration of three internodes.
- 8-Discolouration of four internodes.
- 9-Discolouration of five internodes.
- 10-Plant prematurely killed.

Percentage of reduction of infection was calculated by the formula :—  $100 \left\{ \frac{\text{Disease index with Bleaching Powder treatment}}{\text{Disease index of untreated (control)}} \right\} \times 100$ .

### RESULTS

Application of Bleaching Powder considerably reduced the incidence of *M. phaseolina* on maize in sick plots (Table 1). Best result was obtained when the

Table 1. *Effect of Bleaching Powder (1000 ppm) on the incidence of charcoal rot of maize caused by Macrophomina phaseolina. 1*

| Treatment           | % Plant infected | % Plant killed | Disease index | % Reduction of infection |
|---------------------|------------------|----------------|---------------|--------------------------|
| 30 days             | 50.0             | 22.5           | 3.5           | 41.6                     |
| 45 days             | 47.5             | 17.5           | 3.0           | 50.0                     |
| 60 days             | 20.0             | 5.0            | 2.0           | 66.6                     |
| Untreated (control) | 66.4             | 33.0           | 6.0           | —                        |

1 Results are an average of 4 replications of each treatment

chemical was applied with 60 days old plants followed by its application with 45- and 30 days ages of plants respectively. Incidence was much less when treated with 60 days old plants with only 20% infected and 5% killed (disease index 2.0 and 66.6% reduction of infection) as compared to untreated (control) where about 66.4% were infected and 33.3% killed (disease index 6.0). When applied with 30- and 45 days old plants 50% were infected with 20% killed (disease index 3.5 and 41.6% reduction of infection), and 47.5% were infected with 17.5% killed (disease index 3.0 and 50% reduction of infection) in the respective cases. Phytotoxicity was not observed in any case and the plants developed normal ears and tassels.

## DISCUSSION

On maize, charcoal rot (*M. phaseolina*) is recently becoming prevalent in the plains of West Bengal particularly in the Rabi crop that is exposed to high summer temperature (35-40°C) from the flowering stage. Bacterial stalk rot (*E. chrysanthemi*) on the other hand, has been found to be prevalent at Kalimpong and its adjacent areas where it is gradually gaining its importance (Kaiser and Sen Gupta, 1979). Local cultural practice of application of sewage water prior to sowing, and also late sowing (end of May to the mid June) of the crop might be the main predisposing factors for the progressive severity of this disease.

Chemical control of *Erwinia* stalk rot on maize with stable Bleaching Powder have been successfully demonstrated by several workers (Sangam Lal *et al.*, 1970; Thind and Payak, 1972). The present studies also amply demonstrate that charcoal rot of maize can effectively be controlled in the sick plots by the application of this chemical as soil drench. About 41.6-66.6% incidence of the disease was checked when Bleaching Powder was applied to soil in different split doses. Late application with 60 days old plants, a few days flowering, was proved to be more effective than early applications with 30-and 45 days plants respectively. Symptoms of charcoal rot generally appear at the time of flowering when the crop approaches maturity. Bleaching Powder when applied to the soil gradually loses its effectiveness with time due to loss of chlorine. The early application of this chemical long before the onset of flowering might have resulted in loss of its effectiveness against the pathogen (*M. phaseolina*) and allowing enough time for its revival and building up of inoculum again in the soil.

The present studies clearly indicate the potentiality of Bleaching Powder as a fungicidal agent against *M. phaseolina* in the soil.

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